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I hereby certify that on March 27, 2003, the date that I am signing this certificate, this correspondence and any attachments are being deposited with the United States Postal Service, first Class Mail, postage pre-paid, in an envelope addressed to the Assistant Commissioner for Patents, Washington, DC 20231.

Jennifer D. Ahearn
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PATENT
Atty. Docket No. 35236-1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Daniel Lopez, et al.

Serial No.: 09/249,728

Group Art Unit: 2623

Filed: February 13, 1999

Examiner: M. Dastouri

For: Reticle Defect Detection Using Simulation

TRANSMITTAL LETTER

Assistant Commissioner for Patents
Washington, DC 20231

Sir:

Transmitted herewith is an amendment in the above-identified application and the following:

☒ No additional claim fee is required.

☐ Additional fees are required as calculated and shown below:

	Claims Remaining After Amendment	Highest Number Previously Paid For	Number Extra	Small Entity Rate	Additional Fee	Standard Rate	Additional Fee
Total	22 minus	22		x $9.00		x $18.00	
Independent	6 minus	6		x $42.00		x $84.00	
1st Presentation of Multiple Dependent Claim				x $140.00		x $280.00	
				TOTAL:		TOTAL:	

☐ A Petition for [ ] One; [ ] Two; [ ]Three Month Extension of Time and the requisite fee is being filed concurrently herewith.

☐ Other attachments:_____

☒ The Commissioner is hereby authorized to charge payment of the following fees associated with this communication or credit any overpayment to our Deposit Account No. 13-3735. A duplicate copy of this sheet is enclosed.

☒ Any additional filing fees required under 37 C.F.R. 1.16.
☒ Any patent application processing fees under 37 C.F.R. 1.17.

Respectfully submitted,

MITCHELL, SILBERBERG & KNUPP LLP

Date: March 27, 2003

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For: Reticle Defect Detection Using Simulation

AMENDMENT/RESPONSE TO OFFICE ACTION

Assistant Commissioner for Patents
Washington, DC 20231

Sir:

The following responds to the Office Action dated December 27, 2002.

Claims 1 to 22 remain pending in the application, with claims 1, 9, 17, 19, 21 and 22 being the independent claims. Reconsideration and further examination are respectfully requested.

In the Office Action, claims 1 to 13, 16, 17, and 19 were rejected under 35 U.S.C. § 102(e) over U.S. Patent 5,965,306 (Mansfield); claims 14, 15, 18 and 20 to 22 were rejected under § 103(a) over Mansfield in view of U.S. Patent 5,619,429 (Aloni); claims 1 to 4, 6 to 11, 13 to 17, 19, 21 and 22 were rejected under § 103(a) over Aloni in view of U.S. Patent 6,016,357 (Neary); claims 5 and 12 were rejected under § 103(a) over Aloni in view of Neary and Mansfield; and claims 18 and 20 were rejected under § 103(a) over Aloni in view of Neary and U.S. Patent 6,171,731 (Medvedeva). Withdrawal of these rejections is respectfully requested for the following reasons.

The present invention concerns improved techniques for detecting defects in a reticle used in manufacturing integrated circuits. Unlike conventional defect-detection techniques, the present invention processes digital image data corresponding to an image of a reticle in order to identify defects and to simulate the response that would be produced if the reticle were to be utilized in a photolithographic system. As a result, the present invention generally can facilitate the identification and classification of defects much more efficiently than conventional techniques would allow.

Thus, independent claims 1, 17 and 21 are directed to detecting defects in a reticle used in integrated circuit fabrication, in which digital image data corresponding to an image of a reticle are obtained. Such digital image data are processed according to predetermined criteria to identify defects, and a response that would be produced if the reticle were to be used in a photolithographic system is simulated, by processing the digital image data corresponding to the reticle.

Independent claims 9, 19 and 22 are directed to detecting defects in a reticle used in integrated circuit chip fabrication, in which digital image data corresponding to an image of a reticle are obtained. The digital image data are processed according to predetermined criteria to identify defects and a window is specified around one of the identified defects. Then, a response that would be produced if the specified window were to be utilized in a photolithographic system is simulated by processing digital image data corresponding to the specified window.

The foregoing combinations of features are not disclosed or suggested by the applied art. In particular, the applied art does not appear to disclose or to suggest at least the features of processing digital image data corresponding to an image of a reticle (or a portion thereof) to simulate a response that would be produced if the reticle (or portion thereof) were to be utilized in a photolithographic system.

The § 102(e) rejection over Mansfield is believed to be inappropriate in that Mansfield does not appear to say anything at all about processing digital image data in any manner whatsoever. Although the Office Action cites certain portions of Mansfield as showing the features of obtaining and processing digital image data, Applicants have carefully reviewed those portions of Mansfield and are unable to find any mention at all of digital image data. The following paragraphs respond to the arguments made in the corresponding numbered paragraphs beginning on page 3 of the Office Action.

Paragraph 3(a) of the Office Action: Column 2, lines 1 to 15, of Mansfield merely discusses the use of an AIMS microscope for emulating lithographic exposure

conditions, and says nothing at all about digital image data. Column 5, lines 7 to 12, merely discusses the use of *a priori* knowledge about how variations in the sizes of features on a photomask affect wafer image, and also says nothing at all about digital image data. Accordingly, neither portion of Mansfield discloses the feature of obtaining digital image data corresponding to an image of a reticle.

Paragraph 3(b) of the Office Action: Element 208 in Figure 2 merely recites a step of inspecting a mask for defects, and also says nothing at all about digital image data. Similarly, element 305 in Figure 3 merely recites a step of building/inspecting a mask, and says nothing at all about digital image data. Element 411 in Figure 4 recites the same step as element 208, discussed above. Column 6, line 62 to column 7, line 8, generally discusses the classification of defects by comparing process windows of features close to a defect with corresponding features in a mask that does not include a defect; it also says nothing at all about digital image data. Accordingly, none of these portions of Mansfield discloses the feature of processing digital image data corresponding to an image of a reticle (or portion thereof) according to predetermined criteria to identify defects.

Paragraph 3(c) of the Office Action: Column 4, line 66 to column 5, line 12 generally discusses classification of defects in a mask by analyzing images of features close to a subject defect, taking multiple images that approximate the image of the mask that will be printed on the wafer under different variations in the lithographic process; however, no mention whatsoever is made of digital image data. Column 7,

lines 41 to 50, generally discusses analysis of the lithographic process using various optical techniques after a lithographic metric has been defined; this portion of Mansfield also says nothing at all about digital image data. Column 8, line 54 to column 9, line 20 discusses use of an AIMS microscope to inspect a given mask and also says nothing at all about digital image data. Thus, these portions of Mansfield are silent about the present invention's feature of simulating a response that would be produced if a reticle (or portion thereof) were to be utilized in a photolithographic system, by processing digital image data corresponding to an image of the reticle (or portion thereof).

In short, Mansfield only appears to discuss the analysis of pre-identified defects using optical tools in order to inspect a given mask. In his preferred embodiment, Mansfield uses an AIMS microscope to simulate (or emulate) the response of a pre-defined photolithographic system. However, this simulation is optical, as can clearly be seen from a review of Mansfield's claim 27 ("wherein said lithographic images are aerial images, said aerial images being generated by an imaging system that emulates a lithographic exposure tool, said imaging system being referred to as an aerial image measurement system (AIMS)" *[emphasis added]*). The optical nature of such AIMS simulation is further evidenced by the IBM article titled, "Development and Application of a New Tool for Lithographic Mask Evaluation, the Stepper Equivalent Aerial Image Measurement System, AIMS", previously submitted by Applicants and now cited in the Office Action. Such optical simulation has nothing to at all to do with processing digital image data to simulate a response.

In addition, while Mansfield discusses the problem of classifying identified defects, he does not appear to say anything at all about identifying the defects in the first instance. Accordingly, he could not possibly have said anything about processing digital image data corresponding to an image of a reticle (or portion thereof) in order to identify such defects.

In view of the significant differences between Mansfield and the present invention, withdrawal of the rejection over Mansfield is respectfully requested. Similarly, claims 21 and 22 have been rejected over Mansfield in view of Aloni, with the Office Action principally relying upon the same arguments made when rejecting claims 1 and 9 under Mansfield and adding Aloni solely for the purpose of disclosing a processor for executing stored program instruction steps. For the same reasons set forth above, the principal limitations of claims 21 and 22 are not believed to be shown by Mansfield. Moreover, it is not believed that there would have been any motivation to incorporate such a processor into Mansfield's system in any manner that would have resulted in the present invention, as Mansfield does not appear even to allude to the processing of digital image data. For these reasons, claims 21 and 22 are believed to be allowable over any permissible combination of Mansfield and Aloni.

As to the § 103(a) rejection over Aloni in view of Neary, the Office Action acknowledges that Aloni fails to disclose or to suggest simulating a response that would be produced if a reticle (or window within the reticle) were to be utilized in a photolithographic system by processing digital image data corresponding to the reticle

(or window). However, the Office Action then cites Neary as showing this feature of the invention, and asserts that it would have been obvious to combine the two references.

Applicants disagree with this characterization of Neary. While Neary simulates (or emulates) the exposure tool upon which a given mask is to be used, such simulation appears to be done optically, rather than by processing digital image data corresponding to a reticle or a portion thereof. Thus, for example, column 6, line 25 to column 7, line 4 discusses the use of an aerial image measurement tool to emulate the aerial image that would be produced by a defective mask. This tool is described in more detail at column 3, lines 55 to 65 of Neary. There, the tool is described as an AIMS microscope that is used "to measure the intensity of the aerial image created by illuminating the mask with the desired light source." *Emphasis added.* Similarly, Neary's Abstract talks about "illuminating the mask to create an aerial image of the mask". A digital simulation generally would not require such illumination and measurement.

> Neary's aerial image measurement tool is further described as follows:
>
> "The device includes apertures that can emulate commercially available printing tools (e.g., Nikon EXX and Microscan II and III) and has is the ability to use the working wavelength of the light to be employed (248 and 365 nanometers)." Column 3, lines 61 to 65.

The foregoing references to the device including "apertures" and having "the ability to use the working wavelength of the light to be employed" all are characteristic of an optical emulation device, and not of a device that simulates a response by processing

digital image data. Moreover, as noted above and as clearly set forth in the previously cited IBM article concerning AIMS microscopes, an AIMS microscope is used to perform optical simulations (or emulations), not digital simulations.

While the referenced portion of Neary discusses the use of "a simulator to predict the ideal aerial image, for example, in the case of grouped or isolated lines, by superimposing straight lines separating by the design CD," this has nothing to do with simulating a response that would be produced if an actual reticle were to be utilized in a photolithographic system. Rather, as can be clearly seen from the foregoing quotation, such simulation only produces an ideal aerial image. Moreover, even that ideal aerial image does not appear to be produced by processing digital image data in any manner whatsoever, much less by processing digital image data that corresponds to an actual reticle or portion thereof.

In the Office Action, particular emphasis is placed on column 6, lines 59 to 65 of Neary. However, that portion of Neary has been reviewed in detail and is not seen to say anything at all about the feature of simulating a response to a photolithographic system by processing digital image data corresponding to an image of a reticle (or portion thereof). Rather, that portion of Neary merely discusses calculating the difference between the optically simulated aerial image for the sample mask and the projection of the ideal aerial image. Figures 2, 10 and 16 also have been reviewed, but are not seen to disclose anything that would make up for the foregoing shortfalls of Neary in this regard.

In short, neither Aloni or Neary discloses or suggests the feature of simulating a response that would be produced if a reticle (or portion thereof) were to be utilized in a photolithographic system, by processing digital image data corresponding to an image of the reticle or portion thereof. Accordingly, no permissible combination of these two references would have rendered the present invention obvious.

Applicants previously have presented arguments similar to those above on numerous occasions in this case, and have even appealed once already. Despite this, there has been no specific reference to anything in the applied art references that would refute the above points. Applicants continue to believe that the present claims are allowable over the applied art for all of the reasons set forth above. If the Examiner disagrees, then Applicants respectfully request the citation of specific references that refute each of the foregoing points.

The other claims in the application depend from the independent claims discussed above, and are therefore believed to be allowable for at least the same reasons. Each such dependent claim recites at least one additional feature that further distinguishes the invention from the applied art. Accordingly, the individual consideration/reconsideration of each on its own merits, particularly in view of the foregoing remarks, is respectfully requested.

In view of the foregoing remarks, the entire application is believed to be in condition for allowance, and an indication to that effect is respectfully requested.

If there are any fees due in connection with the filing of this paper that have not been accounted for in this paper or the accompanying papers, please charge the fees to our Deposit Account No. 13-3735. If an extension of time under 37 C.F.R. 1.136 is required for the filing of this paper and is not accounted for in this paper or the accompanying papers, such an extension is requested and the fee (or any underpayment thereof) should also be charged to our Deposit Account. A duplicate copy of this page is enclosed for that purpose.

Respectfully submitted,

MITCHELL, SILBERBERG & KNUPP LLP

Dated: March 27, 2003

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